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4. CHARACTERIZATION OF GAS DEMANDS OF ELECTRIC GENERATORS

The results of our electric system analysis are presented in this chapter. The discussion focuses on the fuel demands created by generators that burn either natural gas or oil (residual oil or distillate oil), or both gas and oil. For gas-capable units, these results represent the maximum potential demand for gas, as defined in the first chapter of this report. These maximum potential demands form the inputs to the gas model. As such, they are independent of the gas system's ability to deliver the desired amounts of gas. The results of our analysis of the gas systems' ability to meet total gas demands, and the resulting gas deliveries to electric generators are presented in Chapter 5.

In this chapter we outline how potential gas demands will change across years and scenarios. Electricity capacity additions are outlined in the first section of the chapter. The total fuel demands for gas and oil capable units, corresponding to each of the electricity capacity expansion scenarios, are presented next. The chapter closes with a discussion of the intra-day (hourly) gas demands created by the hourly operating patterns of gas-fired generation.

4.1 ELECTRIC GENERATION CAPACITY EXPANSION SCENARIOS

Our analysis has examined daily gas demands among electric generators and the corresponding ability of the gas system to meet those demands on a daily basis for five electric system conditions: three generation capacity addition cases for 2005, along with cases for 2002 and 2010. Our 2002 case includes all currently operating power plants along with new plants and upgrades to existing plants that are currently under construction and will commence operation during 2002. Our 2005 cases include 1,030 MW, 1,780 MW or 4,435 MW of new capacity, as shown in Table 1 below. For 2010, in addition to the new units included in the 2005 case with 4,435 MW, one additional CC plant was added on Long Island, for a total of 5,015 MW.[23]

The capacity additions in the 4,435 MW case correspond to those included in the new capacity assumptions used in the analysis supporting the December 2001 Draft NYSEP, updated to reflect the status of projects as of April 2002. This set of units includes all projects that have received Article X approval, as well as several repowering and/or expansion projects at existing sites. Merchant generating companies have encountered difficult economic conditions throughout the United States, and their financial performance has suffered substantially. The poor financial health of generating companies, coupled with relatively low futures prices for electricity, has lead companies to slow project development activities. This slowdown raises the likelihood that only a portion of those units receiving Article X approval will be constructed on their original schedule. To reflect the possibility that fewer units are constructed in the NYCA over the next few years, we also examined 2005 scenarios with fewer new generator additions. The set of units included in these cases is also shown in the table below. In the first of these cases, the

[23] Note that no additional capacity beyond the projects included in our 4,435 MW case is needed to meet the 2010 ICAP requirements.

Athens project (under construction) and East River project (interconnection facilities are under construction) were included along with the Ravenswood cogeneration facility and the planned expansion at the Poletti Station, for a total of 1,780 MW. The Ravenswood, East River, and Poletti projects were included to represent the proposed projects located in New York City. To date, these projects have not announced any delays in their planned in-service dates. Only the Athens and East River projects were included in the most restrictive case, for a total of 1,030 MW of net additions over the 2003–2005 period. Table 2 shows the NYCA load and reserve margin for each of these cases.

Table 1
Electric Generation Capacity Additions and Retirements

Unit Name	Status	Type	Installation Date	Retirement Date	Planned Summer Capacity (MW)	Capacity Included in 4,435 MW Case	Capacity Included in 1,780 MW Case	Capacity Included in 1,030 MW Case
Additions and Retirements Prior to 2003								
Astoria Unit 2	Operating	Steam (Oil)	6/1/00		171	171	171	171
Hudson Avenue 10/100 Unit	Operating	Steam (Oil)	6/1/01		60	60	60	60
Various Unit Upratings	Operating		6/1/01		165	165	165	165
NYPA Hell Gate	Operating	CT	6/1/01		80	80	80	80
NYPA Vernon	Operating	CT	6/1/01		80	80	80	80
NYPA Fox Hills	Operating	CT	6/1/01		44	44	44	44
NYPA 23rd Street	Operating	CT	6/1/01		80	80	80	80
NYPA Harlem Rail	Operating	CT	6/1/01		80	80	80	80
NYPA River Street	Operating	CT	6/1/01		44	44	44	44
Various Wind Projects	Operating	Wind	10/15/01		42	42	42	42
Carlson Addition	Under Construction	CT	1/15/02		39	39	39	39
NYPA Pilgrim State Hospital	Under Construction	CT	6/1/02		44	44	44	44
LIPA Additions	Under Construction	CT	6/1/02		360	360	360	360
Various Unit Upratings	Under Construction		6/1/02		123	123	123	123
Total Net Additions Prior to 2003						**1,412**	**1,412**	**1,412**
Additions and Retirements 2003-2005								
Miscellaneous Renewables	Planned	Wind	1/1/03		30	30	30	30
Ravenswood	Approved	CC	1/1/03		250	250	250	
Con Edison East River	Approved	Cogen	1/1/03		360	360	360	360
LIPA Additions	Under Construction	CT	6/1/03		160	160	160	160
Miscellaneous Renewables	Planned	Wind	6/1/03		45	45	45	45
Waterside 6, 8, 9	Retired with E River Addition	Steam (Oil)		1/1/03	(164)	(164)	(164)	(164)
Heritage (Independence)	Approved	CC	1/1/04		800	800		
Hudson Avenue 10/100 Unit	Planned Retirement	Steam (Oil)		1/1/04	(60)	(60)	(60)	(60)
Athens Generating Plant (Greene)	Under Construction	CC	1/1/04		1,080	1,080	1,080	1,080
Orion Astoria Repowering Phase I	Application Complete	CC	1/1/04		908	908		
Astoria Unit 5	Retired with Astoria Phase I	Steam (Dual)		1/1/04	(361)	(361)		
Astoria Unit 2	Retired with Astoria Phase I	Steam (Oil)		10/1/02	(171)	(171)		
Miscellaneous Renewables	Planned	Wind	6/1/04		45	45	45	45
Albany	Approved	CC	1/1/05		750	750		
Albany 1-4	Retired with Albany Repowering	Steam (Dual)		1/1/05	(363)	(363)		
SCS Queens (Astoria) 1	Approved	CC	1/1/05		900	900		
Orion Astoria Repowering Phase II	Application Complete	CC	1/1/05		908	908		
Asotria Units 3 and 4	Retired with Astoria Phase II	Steam (Dual)		1/1/05	(716)	(716)		
Poletti Expansion	Application Complete	CC	1/1/05		500	500	500	
Various Unit Retirements	Retirements			1/1/05	(511)	(511)	(511)	(511)
Miscellaneous Renewables	Planned	Wind	6/1/05		45	45	45	45
Total Net Additions 2003-2005						**4,435**	**1,780**	**1,030**
Additons After 2005								
Long Island CC		CC	1/1/10		580	580		
Total New Additions 2003-2010						**5,015**		

Table 2

NYCA Reserve Margins Under Various Capacity Addition Scenarios

		2002	2005 18% Reserve Margin	2005 4,435 MW Case	2005 1,780 MW Case	2005 1,030 MW Case	2010
NYCA	Existing Capacity	36,259	36,259	36,259	36,259	36,259	36,259
	2002 Planned Additions	522	522	522	522	522	522
	Additional New Capacity (Net of Retirements)	-	244	4,435	1,780	1,030	5,015
	Total Capacity	36,781	37,025	41,216	38,561	37,811	41,796
	Load	30,475	31,377	31,384	31,384	31,384	32,824
	Capacity/Load (%)	121%	118%	131%	123%	120%	127%
	Reserve Requirement (18%)	5,486	5,648	5,649	5,649	5,649	5,908
	Capacity in Excess of Requirement	821	-	4,183	1,528	778	3,064
NY City	Existing Capacity	8,707	8,707	8,707	8,707	8,707	8,707
	2002 Planned Additions	123	123	123	123	123	123
	Additional New Capacity (Net of Retirements)	-	(18)	2,353	904	136	2,353
	Total Capacity	8,830	8,812	11,183	9,734	8,966	11,183
	Load	10,665	11,015	11,015	11,015	11,015	11,453
	Capacity/Load (%)	83%	80%	102%	88%	81%	98%
	Locational Capacity Requirement (80%)	8,532	8,812	8,812	8,812	8,812	9,162
	Capacity in Excess of Requirement	298	-	2,371	922	154	2,021
Long Island	Existing Capacity	4,545	4,545	4,545	4,545	4,545	4,545
	2002 Planned Additions	360	360	360	360	360	360
	Additional New Capacity (Net of Retirements)	-	(380)	160	160	160	740
	Total Capacity	4,905	4,525	5,065	5,065	5,065	5,645
	Load	4,776	4,866	4,866	4,866	4,866	5,129
	Capacity/Load (%)	103%	93%	104%	104%	104%	110%
	Locational Capacity Requirement (97% 2002, 93% 2005)	4,633	4,525	4,525	4,525	4,525	4,770
	Capacity in Excess of Requirement	272	-	540	540	540	875

4.2 FUEL DEMANDS FOR ELECTRICITY GENERATION

Annual fuel demands among gas-fired and dual-fueled units increase only slightly, about 2 percent, between 2002 and the 2005 case with 4,435 MW of new capacity. This is shown in Table 3, below. In the winter months, generation from new CC units replaces generation from less-efficient gas-fired units and from some existing, nongas units, as well as some imports, for a net increase in winter gas demands.. In the summer months, the shift in generation from steam units to more efficient CC units outweighs the shift from nongas units and imports to CCs, resulting in a slight decrease in total New York gas demand for power generation.

Table 3

Annual Maximum Potential Fuel Demands
For Gas-Fired and Dual-Fueled Electric Generation (Million MMBtu)

	Winter (Jan-Apr, Oct-Dec)			Summer (May-Sep)			Annual		
Year/Case	Combined Cycle and GT units	Dual-Fueled Steam Units	Total	Combined Cycle and GT units	Dual-Fueled Steam Units	Total	Combined Cycle and GT units	Dual-Fueled Steam Units	Total
2002	130	137	267	106	115	221	236	252	488
2005 – 1,030 MW Case	153	121	274	119	110	229	271	231	503
2005 – 1,780 MW Case	174	100	274	129	94	223	303	194	496
2005 – 4,435 MW Case	243	38	281	177	40	217	420	78	498
2010	282	42	324	214	50	264	495	93	588

In addition to the change in overall gas demand among these units, there is also a shift in the types of units consuming the gas. In 2002, gas use is split almost evenly between gas turbine and cogeneration units, and steam units that can also burn residual oil. In 2005, the generation mix shifts to new CC units so that only a small portion of statewide electricity generation (and the associated gas demand) comes from steam units that are dual-fuel capable. To the extent that new CC units do not have storage, or resupply capabilities comparable to the existing dual-fuel steam units that they replace, NYCA generation will become increasingly dependent on receiving gas. However, as long as the steam units are not retired, they will remain available and can generate using residual oil in times when the CCs are unable to get their full, unrestricted gas deliveries.

The table also shows gas demands under each of the 2005 capacity addition scenarios. When new CC capacity is added, peaking units, many of which burn oil rather than gas, are displaced first. Hence, when fewer new CC units are added, many of the steam units are still needed to meet load in a significant number of hours. As a result, gas demands are higher when capacity additions are more limited, and decrease when enough CC units are added that a substantial portion of gas-fired steam generation is displaced (as in the 4,435 MW and 1,780 MW cases).

Between 2005 and 2010, power generation gas demands increase in both the summer and winter. Because almost no additional capacity needs to be added between 2005 and 2010 (to meet locational and statewide installed capacity requirements), increases in gas requirements between 2005 and 2010 attributable to electric load growth are not offset by a shift in generation to more efficient gas-fired units, as in 2005. Rather, both the new CC units, and older steam and GT units all run more in 2010, relative to their 2005 operating levels. Hence, total NYCA requirements for gas and/or oil increase by approximately 18 percent between 2005 (4,435 MW case) and 2010.

Table 4 shows fuel use on the summer and winter peak electric days. As with total annual gas demand, between 2002 and 2005, peak-day demand increases slightly in the winter and decreases slightly in the summer. Comparing the 2005 peak demands among the capacity addition scenarios shows that during peak periods, the steam units still generate substantial amounts if only limited combined-cycle capacity is added, as the new units displace mostly imports and generation from oil-fired units, including peakers.

Table 4

Peak (Electric) Day Maximum Potential Fuel Demands for Gas-Fired and Dual-Fueled Electric Generation (Million MMBtu)

	Winter Peak			Summer Peak		
Year/Case	Combined Cycle and GT units	Dual-Fueled Steam Units	Total	Combined Cycle and GT units	Dual-Fueled Steam Units	Total
2002	0.40	0.98	1.38	0.94	1.54	2.48
2005 -- 1,030 MW Case	0.50	0.94	1.39	1.04	1.52	2.57
2005 -- 1,780 MW Case	0.58	0.91	1.48	1.17	1.38	2.55
2005 -- 4,435 MW Case	0.91	0.50	1.41	1.52	0.94	2.46
2010	1.21	0.57	1.78	1.81	1.08	2.88

As described above, the addition of new combined-cycle capacity shifts the generating mix away from units that can also burn residual oil toward the CC units. If the gas delivery system is unable to supply the full gas demands of these units, one of two alternatives must be available: (1) the CC will substitute distillate for gas, or (2) the CC will go off-line and non-gas-fired, substitute generating units will need to be committed and dispatched to meet electricity load.

We note that a number of the new CC projects proposed for the downstate region (*i.e.*, East River Repowering, Ravenswood Cogeneration, Poletti Station Expansion, and Bowline Point 3) have barge resupply/backup capabilities, which would provide distillate resupply capability equal to the residual oil re-supply capability for dual-fuel units. If, however, the resupply/backup capability were not available, electric loads could still be met if substitute non-gas-fired generation was available.[24] Non-gas-fired generation would include available "green power" resources, as well as conservation and demand reduction resources. Table 5 shows the extent to which such substitute capacity is available for four electrical regions within New York: New York City, Long Island, Eastern NY (East of the Total East Interface, including New York City and Long Island), and New York State.

For 2002 and 2005 (4,435 MW Case), enough substitute capacity exists (*e.g.*, for winter 2005, 9,195 MW available statewide—3,288 MW of which is dual-fueled steam capacity in Eastern New York) to meet winter peak electric load even if no units are able to get gas deliveries. In 2010, only a small amount of gas-fired generation is needed to meet winter peak electricity load. If the winter peak electricity load were coincident with the peak day gas demand—making gas unavailable for electric generation—NYCA generation would need to be supplemented by imports from adjacent markets to meet NYCA electric loads.

By contrast, in summer 2005, under our 4,435 MW case, a substantial portion the gas-fired CC generation will be operated to meet peak loads, even if we assume that all available oil-capable units (*i.e.*, those units not out on maintenance or forced outages) are generating and on oil. For eastern New York, the 4,435 MW scenario includes 3,505 MW of new combined cycle capacity and the assumed retirement of approximately 2,200 MW of steam capacity.

Given assumed load growth and retirements, approximately 3,100 MW of the new capacity must operate to meet Eastern New York peak loads.[25] Given their high efficiency, however, these new CC will require only about 500 MDT of gas on the peak summer day, an amount substantially below historical summer daily deliveries.

Table 5

Available Substitute Capacity for Gas-Fired Generation, by Type
4,435 MW Capacity Additions Case

Winter Peak

		Peak Hour Gas-Fired Generation (MWh)		Available, Non-Gas (or Dual-Fueled) Substitute Capacity (MW)						
Year	Electrical Transmission Area	Dual-Fueled Units (Gas & Residual Oil)	Gas-Only Units (Distillate Backup Only)	Dual-Fueled Steam	Dual-Fueled Peakers	Oil-Fired Peakers	Oil-Fired Steam	Other	Total	Uncovered Gas-Fired Generation
2002	NYC	2,731	444	1,383		2,035	-	-	3,418	-
	Long Island	756	303	563	118	1,389	-	-	2,069	-
	Eastern NY	5,609	968	2,138	198	3,534	-	-	5,870	-
	NY State	5,609	2,990	2,138	198	3,557	800	53	6,746	-
2005	NYC	1,063	4,472	2,351		1,959		779	5,089	-
	Long Island	974	109	937	134	1,314	-	-	2,386	-
	Eastern NY	3,047	6,614	3,943	215	3,383	-	779	8,320	-
	NY State	3,047	6,735	3,943	215	3,406	800	832	9,195	-
2010	NYC	1,765	4,527	1,128		2,087		779	3,994	533
	Long Island	998	693	751	98	1,032			1,880	
	Eastern NY	3,403	6,420	3,126	178	3,201	-	779	7,284	
	NY State	3,403	8,431	3,126	178	3,224	1,605	832	8,965	

Summer Peak

		Peak Hour Gas-Fired Generation (MWh)		Available, Non-Gas (or Dual-Fueled) Substitute Capacity (MW)						
Year	Electrical Transmission Area	Dual-Fueled Units (Gas & Residual Oil)	Gas-Only Units (Distillate Backup Only)	Dual-Fueled Steam	Dual-Fueled Peakers	Oil-Fired Peakers	Oil-Fired Steam	Other	Total	Uncovered Gas-Fired Generation
2002	NYC	4,919	900	-		1,289	-	-	1,289	-
	Long Island	1,591	696	389	-	853	-	-	1,242	-
	Eastern NY	8,372	2,295	1,367	71	2,233	-	-	3,671	-
	NY State	8,372	4,636	1,367	71	2,256	822	53	4,569	67
2005	NYC	2,957	4,671	-		1,966		-	1,966	2,706
	Long Island	1,467	573	389	108	913	-	-	1,410	-
	Eastern NY	5,890	7,299	1,070	143	2,969	-	-	4,182	3,116
	NY State	5,890	9,822	1,070	143	2,992	1,642	105	5,953	3,870
2010	NYC	3,462	4,755	-		1,882		-	1,882	2,872
	Long Island	1,448	1,031	389	-	500	-	-	889	143
	Eastern NY	6,484	8,130	1,070	71	2,473	-	-	3,614	4,516
	NY State	6,484	11,051	1,070	71	2,496	822	53	4,512	6,539

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24 We define substitute non-gas-fired capacity as capacity that is available to run (*i.e.*, not on maintenance or forced outage) but uncommitted for the day. If conditions required (*e.g.*, gas deliveries to gas-fired generators were restricted), this capacity could be committed to meet local area electric demands.

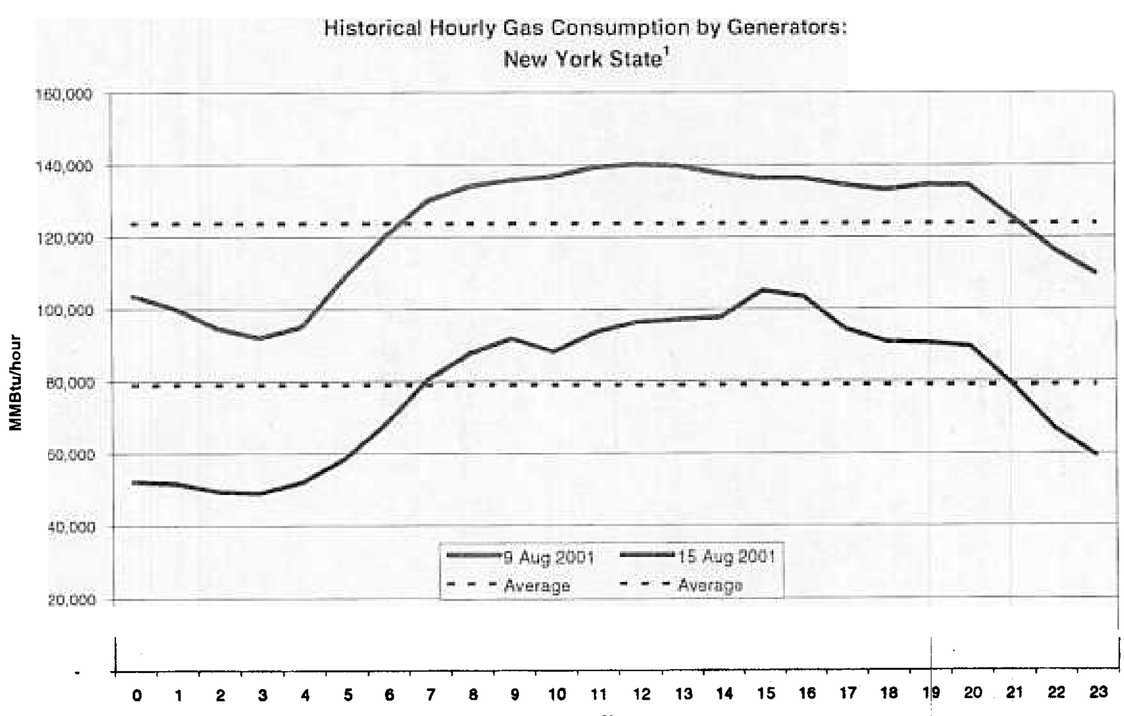
25 The minimum amount of required generation from gas-fired CC can be calculated by committing and dispatching all available non-gas-fired capacity before committing and dispatching the required amount of CC units. The gas deliveries resulting from this dispatch (where non-gas-fired units are dispatched first) establish the minimum amount of gas that would need to be delivered to meet peak NYCA electricity loads, holding imports from adjacent markets constant.

4.3 INTRADAY VARIATION IN GAS DEMANDS FOR ELECTRICITY GENERATION

The above analysis of electric generator gas and oil demands has addressed only total annual and daily fuel use. However, because the hourly electric load shape is not flat within a day, but rather increases substantially from off-peak to peak hours, the gas system may need to deliver substantially more gas in some hours than others. A gas model based on daily demands and delivery capacities does not test the ability of the system to meet either peak-hour demands or the ramp in deliveries that is required as generators ramp up their electric output. In order to better understand whether the intraday variation in gas use exhibited in hourly patterns of fuel use from our MAPS model are feasible, we have examined both historical data and hourly model results.

The gas pipeline and LDC infrastructure has been able to cope with hour-to-hour variation in gas delivery, as can be seen from historical data. Figures 7 and 8 show hourly gas use by New York generators on sample days during summer 2001.[26] As illustrated in the charts, historical gas use for generation has exhibited substantial intraday variation. On each of the days shown, gas deliveries fall well below the daily average during off-peak hours and rise substantially above the average as generators are ramped up during the higher electric load hours.

Figure 7

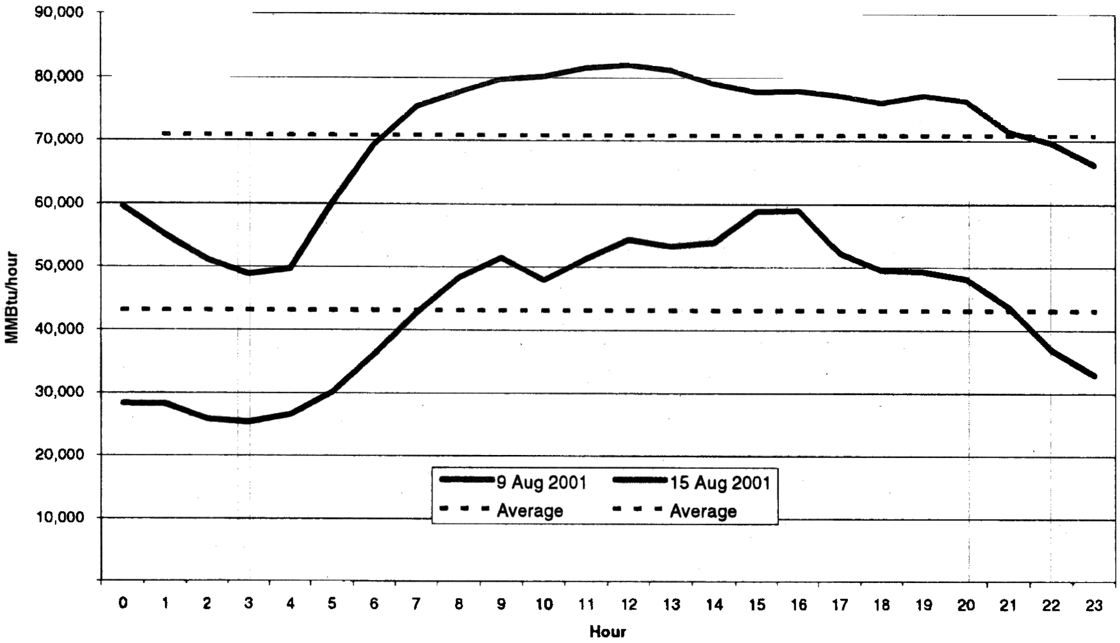


[1]Based on available hourly data for gas-fired units from the U.S. EPA Acid Rain Program. For some generators, either data were not available or the fuel mix was not known. Hence, the total may exclude the gas consumption of some units and/or include some oil consumption from.

[26] These graphs are based on available hourly data for gas-fired units from the U.S. EPA Acid Rain Program. The gas use shown is only approximate, because data were not available for a few generators and the exact fuel mix used in dual-fueled steam units was not known and could only be approximated using SO_2 emissions. Hence, the total may exclude the gas use of some units and include some oil.

Figure 8

Historical Hourly Gas Consumption by Generators: Downstate New York[1]



[1]Based on available hourly data for gas-fired units from the U.S. EPA Acid Rain Program. For some generators, either data were not available or the fuel mix was not known. Hence, the total may exclude the gas consumption of some units and/or include some oil consumption.

As long as the gas system is able to continue to support this type of hourly variation in delivery, and the addition of new gas-fired generation does not increase the required daily ramp in gas deliveries, it is sufficient to analyze gas demands and delivery capabilities on a daily basis when testing for a sustained mismatch between gas demand and supply. Our MAPS results show that this is the case.

Figures 9 and 10 illustrate that the addition of CC units actually decreases intraday variation in fuel demands. Each chart shows the hourly fuel demands of gas-fired and dual-fueled generators on the peak (electric) summer day from the cases with 4,435 MW and 1,760 MW of additions. For both the downstate region and the State overall, off-peak demands are higher and on-peak demands slightly lower in the case with more CC capacity.

Figure 9

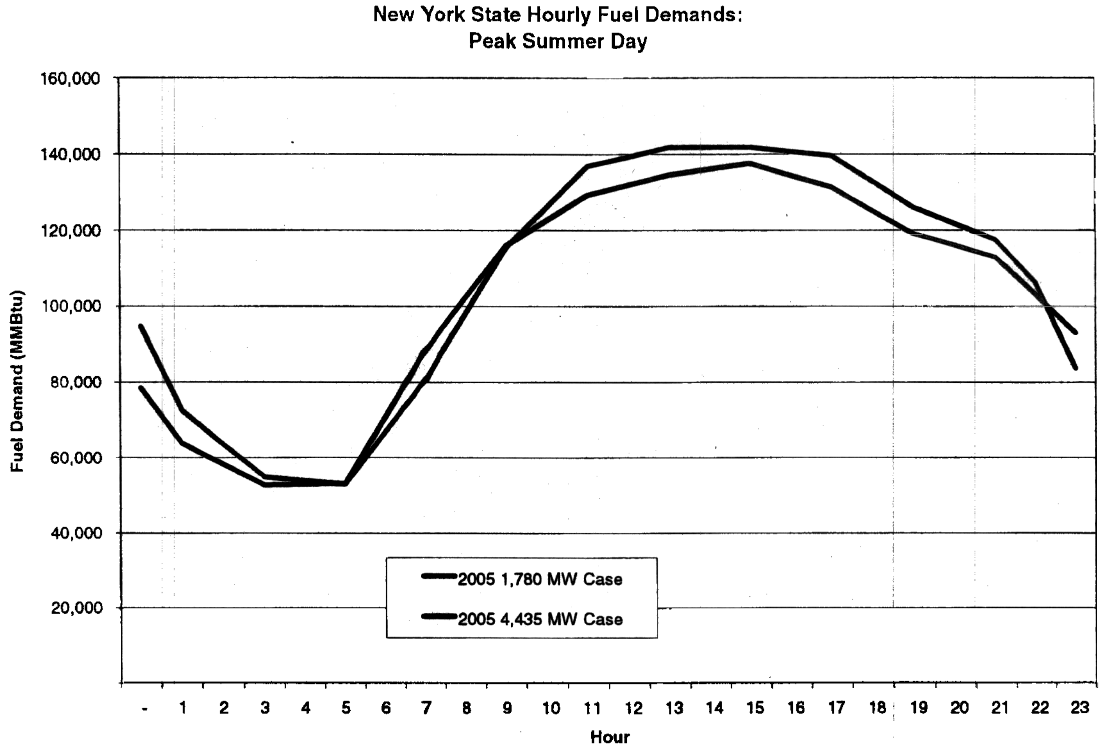
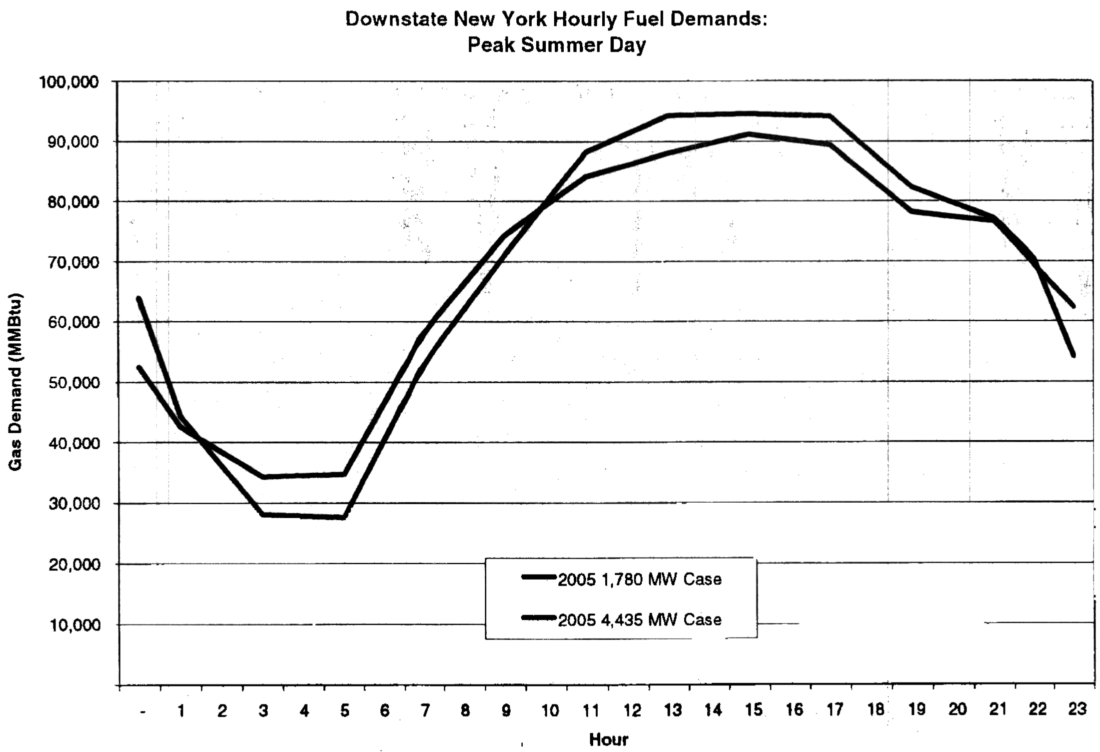


Figure 10



Figures 11 and 12 illustrate why the ramping requirements decrease when more CC units are added. Figure 11 shows downstate gas demands by generator type for the 1,780 MW case. The CC units run at a constant level throughout the day, while steam units and peakers ramp up to meet mid-day loads. As illustrated in Figure 12, in the 4,435 MW case, the combined cycle units still run at a nearly constant rate throughout the day. As a result, overall hourly gas demands are slightly flatter than in the 1,780 MW case.

Figure 11

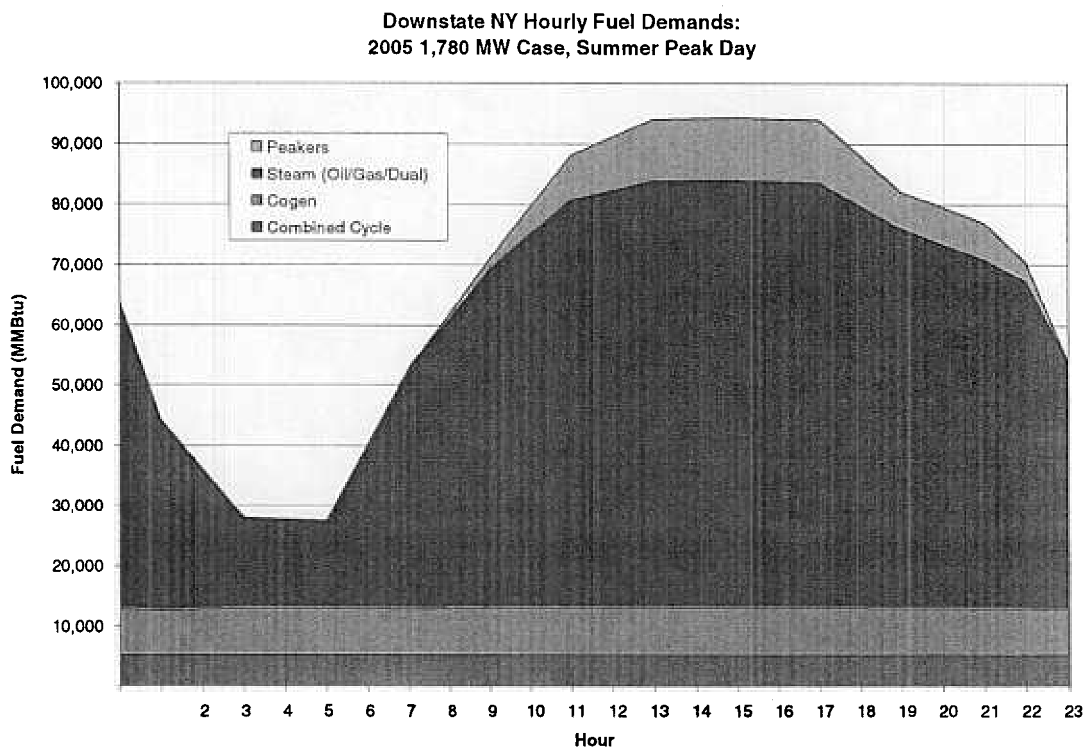
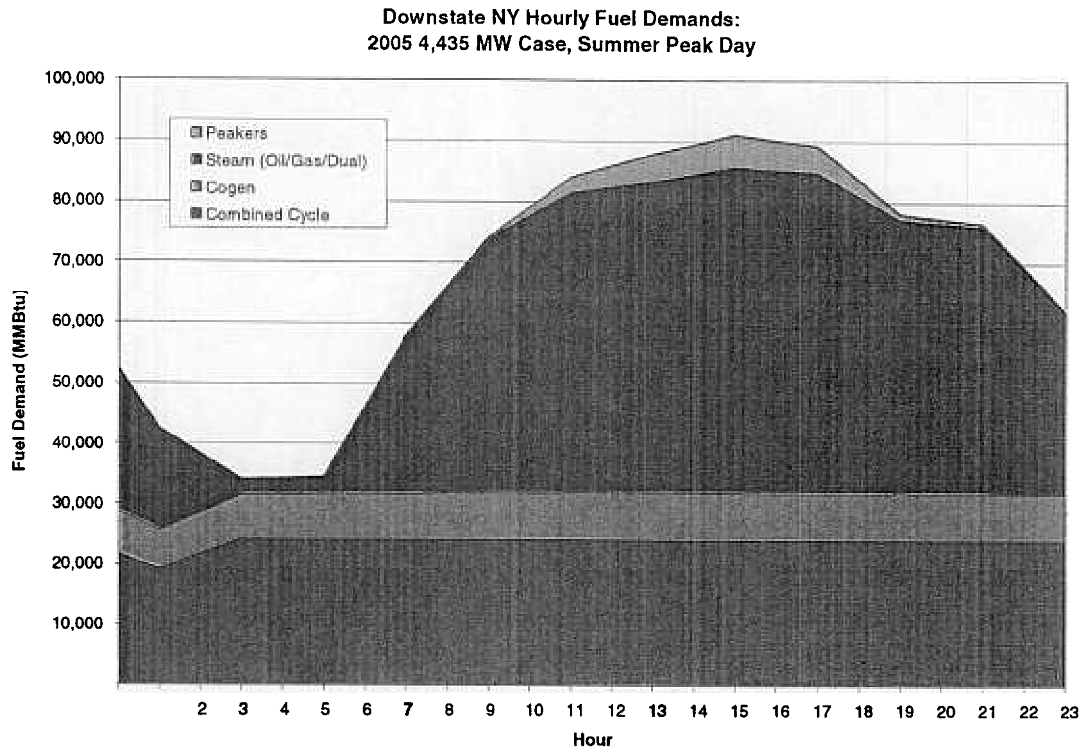


Figure 12



In the winter, when loads are lower, generator capacity additions increase intraday variation slightly, as shown in Figures 13 and 14. The increased intraday variation is not likely to cause hourly gas delivery problems, however, since steam units, which will be burning oil in the winter, do most of the ramping.

Figures 15 and 16 illustrate the generation mix and ramping pattern for the downstate region. In periods when gas delivery is constrained, most of the steam units will be burning oil and therefore will not rely on the gas system for their fuel needs for ramping up. The remaining ramping requirements are relatively small and would put a correspondingly small burden on the gas system if they were met by CCs. Alternatively, however, under constrained gas delivery conditions, many CC plants may be unable to obtain gas or choose not to run because of high gas prices. In those instances, oil-fired units would meet the ramp.

Figure 13

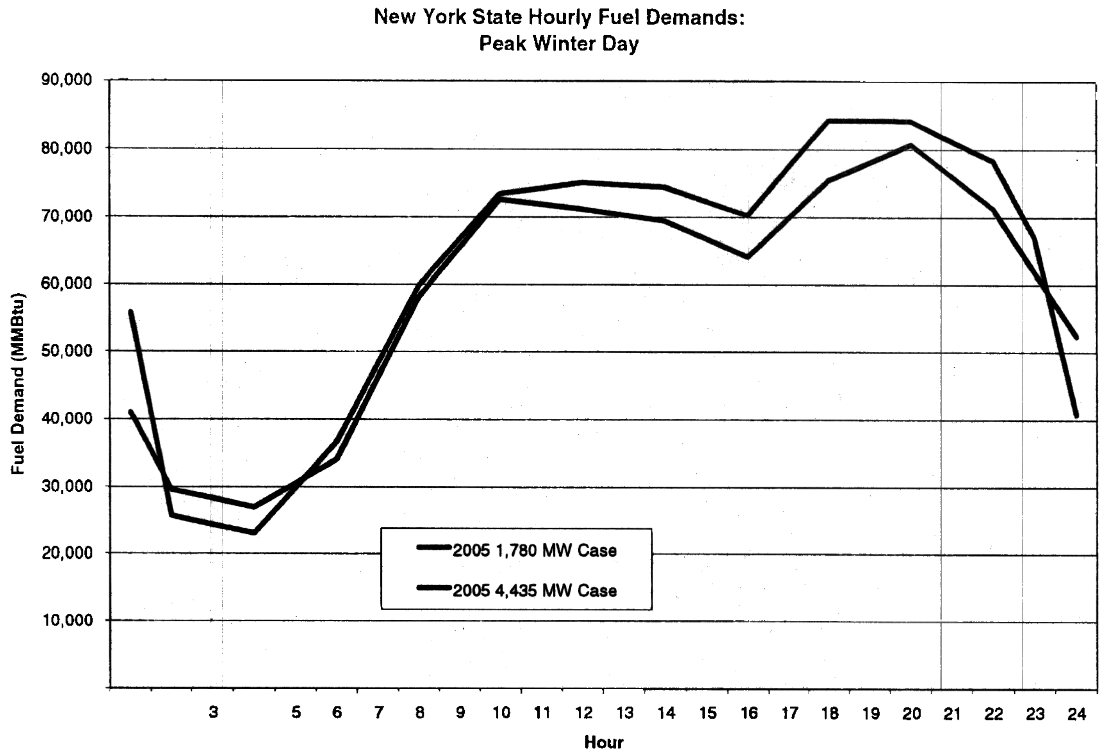


Figure 14

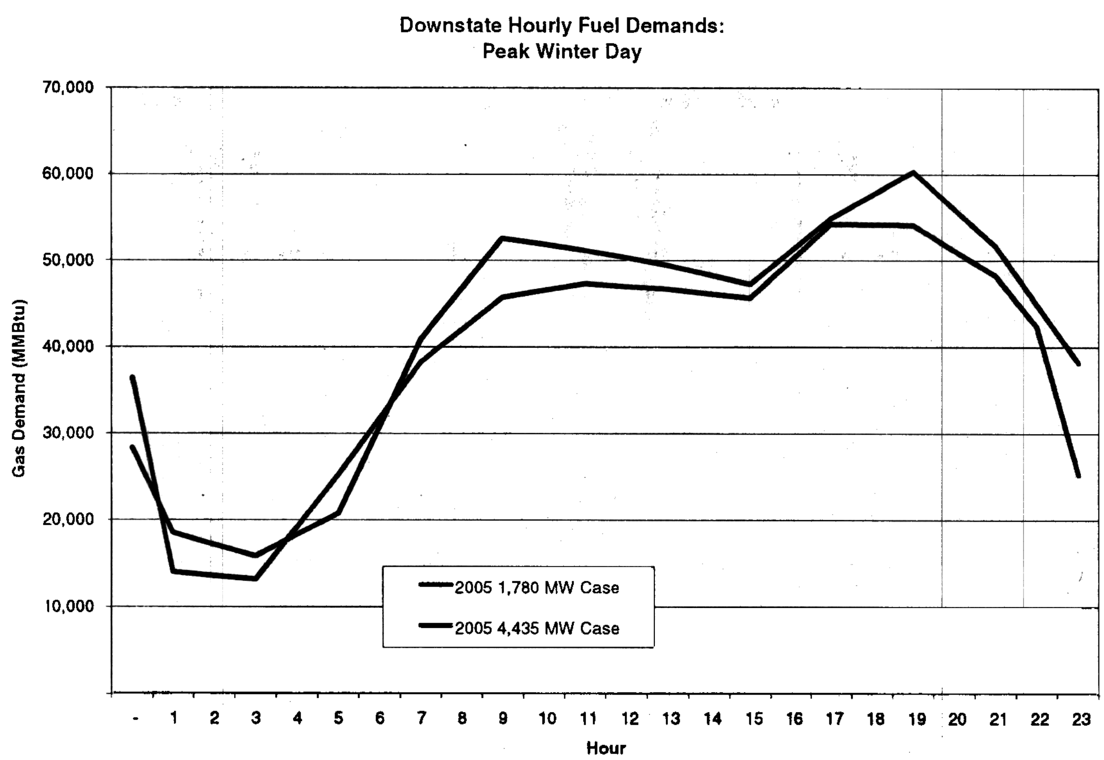


Figure 15

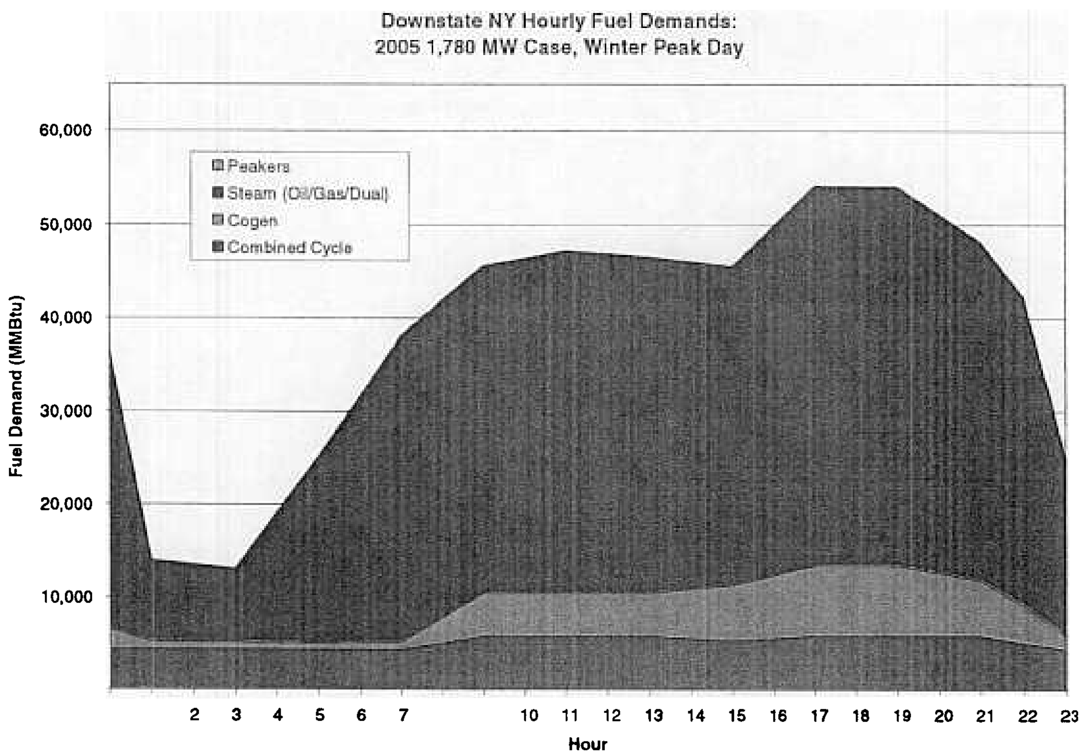


Figure 16